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Condition indicating device for wheeled vehicle shock absorbers

This invention relates to a device for indicating the condition of shock absorbers of wheeled vehicles by using an accelerometer attachable on the vehicle near the shock absorber for emitting a signal which via electronic means results in an indication when a predetermined value function of the vertical speed, is exceeded.

When designing shock absorbers, they are to be dimensioned so as to yield maximum damping without causing the tires at upward motion to loose road hold, and so as to damp sufficiently softly to prevent the vehicle from being bumpy at downward motion. These two criteria imply, that the shock absorber must have properties, which are different for compression and expansion. A worn absorber more and more loses its capacity of damping oscillations. As the absorber works predominantly at compression, the damping for compression consequently decreases relatively rapidly. At a new absorber the difference between the damping at expansion and at compression is great, but decreases with increasing wear. It was, therefore, desired to obtain a reliable indication of worn shock absorbers, preferably from the driver's seat.

One indication arrangement of the kind referred to above in the introductory portion is known from GB—PS 1,483,231. The accelerometer there is located on the vehicle body in order to be actuated by the mechanic oscillations of the body via the shock absorber. When the maximum amplitude of the body oscillation — i.e. the first oscillation — at the passing over a distinctive road irregularity exceeds a certain value, the means becomes operative for releasing a signal to an indication circuit. Thus, the influence of the shock absorber on the first body oscillation at road bumps is measured, which renders an unsafe and gross indication.

Another priority known arrangement of the kind stated in the introductory portion is disclosed in US patent specification 3,383,909. Like the teaching of the GB-patent specification, however, the measurements are performed on the body of the vehicle as affected by the spring force of the shock absorber, resulting in a rough indication of the effect of the shock absorber on said body instead of the condition of the shock absorber, as determined by the axle oscillations representing the effect of the shock absorber on the oscillations generated in the ground-contacting tire surface. — The use, per se, of piezo-electric transducers for measuring vibrations is known from the US patent specification 4,085,349 which, however does not refer to shock absorbers. Further, said transducers are intended to measure the instantaneous velocity of said transducer.

By the present invention, however, an indication is obtained which is both safe and

sensitive, and which is based on measuring the effect of the shock absorber on oscillations, which are generated in the tire surface proper and transferred to the wheel axle. In accordance therewith, the present invention refers to a device for indicating the condition for wheeled vehicle shock absorbers as mentioned in the precharacterizing part of claim 1, said invention being characterized in that the accelerometer is rigidly attached on the vehicle adjacent the hub of the wheel for continuously measuring the accelerations due to the oscillations of the wheel axle induced by vertical irregularities on the road, the device further comprising: an integrating means receiving the signals from the accelerometer and providing a signal corresponding to the difference between vertical speeds of the axle as it rises and drops on encountering an irregularity; a comparator comparing the output signal from the integrator means with a reference signal corresponding to a minimum admissible value of the rising and dropping speed difference of the absorber; an indication means which releases an indication when the output signal reaches the reference value.

The invention is described in greater detail in the following, with reference to the accompanying drawing, in which an embodiment of the arrangement of the invention for indicating worn shock absorbers is illustrated.

In the drawing, a car wheel H with axle A and stationary spring suspension means U and absorber spring indicated at D is shown. The wheel load, and therewith the damping, being approximately symmetric, it is considered sufficient to carry out the measuring of the absorber behaviour at a single one of the four wheels. According to circumstances, however, it may be motivated to measure at several wheels by using identically alike measuring arrangements.

For the indication of the absorber wear, a measure of the aforesaid difference between the damping at expansion and at compression can be obtained by measuring the oscillation of the axle, in order to obtain the difference between vertical speeds of the axle as it rises and drops. The axle oscillation is a measure of oscillations generated in the tire surface and depending on the tire properties (damping and natural oscillation frequency) when the vehicle passes over road irregularities. For measuring the axle oscillations influenced also by the shock absorber, an acceleration transducer G, a so-called accelerometer, is attached to the wheel suspension U. Said accelerometer may be a piezoelectric quartz element, which in the embodiment shown is mounted facing upward on the wheel suspension U, and at its free end supports a metal plate. When the base point of the piezoelectric element is accelerated at the

passing of the vehicle over road irregularities, the point motion is transferred vertically via the piezoelectric element to said plate. The mass inertia of the plate opposes the acceleration motion and thereby momentarily compresses the element. The piezoelectric effect thereof results in a measurable current impulse S, which is proportional to its compression caused by the road bumps via the tire, axle and absorber spring, and the amplitude of which decays due to the damping of the axle oscillation.

The output signal S of the transducer (piezoelectric element) G is passed to a low-pass filter LP in order to eliminate disturbing shock transients in the signal. The output of the filter LP is connected to the input of an amplifier F, the output of which is connected to the input of an integrator means I. The output signal V_a therefrom then is a measure of the difference in the behaviour of the absorber for the rising and dropping speed, respectively, of the wheel axle and is fed to one input of a comparator K. To the second input thereof a reference voltage V_{ref} is fed which corresponds to an acceptable minimum value of said speed difference. The reference voltage V_{ref} can be derived from a region of the damping/frequency characteristic of the tire where the damping is changed little with the variations in the natural oscillation frequency of the tire, while the output signal V_a refers to a region where the frequency dependency of the damping is high. When the signal V_a in question has diminished to the reference voltage V_{ref} , i.e. the difference has decreased to the permissible minimum value, the comparator emits an output signal to an indicator, for example a lamp L, which preferably is mounted on the instrument panel of the car, in order to warn the driver on the poor condition of the shock absorber.

The invention is not restricted to the embodiment described above, but a great number of different modifications can be imagined within the scope of the invention. It is especially possible to use a separate voltage source for generating the reference voltage V_{ref} , instead of deriving it from the tire characteristic. Of course, accelerometers of another kind than piezoelectric ones can be used.

Claims

1. A device for indicating the condition of shock absorbers of wheeled vehicles by using an accelerometer (G) attachable on the vehicle near the shock absorber for emitting a signal (S) which via electronic means (LP, F, I, K) results in an indication when a predetermined value of a function of the vertical speed is exceeded, characterized in that said accelerometer (G) is rigidly attached on the vehicle adjacent the hub of the wheel (H) for continuously measuring the accelerations due to the oscillations of the wheel axle (A) induced by vertical irregularities

on the road, the device further comprising: an integrating means (I) receiving the signals from the accelerometer and providing a signal (Va) corresponding to the difference between vertical speeds of the axle as it rises and drops on encountering an irregularity; a comparator (K) comparing the output signal (Va) from the integrator means (I) with a reference signal (V_{ref}) corresponding to a minimum admissible value of the speed difference of the absorber; an indication means (L) which gives an indication when the output signal (Va) reaches the reference value (V_{ref}).

2. A device as defined in claim 1; characterized in that a low-pass filter (LP) and an amplifier (F) are inserted between the accelerometer (G) and the integrating means (I).

3. A device as defined in claim 1 or 2, characterized in that the accelerometer (G) includes a piezoelectric element.

Patentansprüche

1. Vorrichtung zur Anzeige des Zustandes von Stoßdämpfern an Radfahrzeugen unter Anwendung eines am Fahrzeug nahe dem Stoßdämpfer befestigbaren Beschleunigungsmessers (G) zur Abgabe eines Signales (S), das über eine elektronische Einrichtung (LP, P, I, K) in einer Anzeige resultiert, wenn ein vorbestimmter Wert als Funktion der Vertikalgeschwindigkeit überschritten wird, dadurch gekennzeichnet, daß der Beschleunigungsmesser (G) nahe der Nabe des Rades (H) fest am Fahrzeug angeordnet ist, um kontinuierlich die Beschleunigungen zu messen, die von den durch vertikale Unregelmäßigkeiten der Straße bewirkten Schwingungen der Radachse (A) herrühren, und die Vorrichtung außerdem folgendes umfaßt: eine Integriereinheit (I) zum Empfang der Signale vom Beschleunigungsmesser und zur Abgabe eines Signales (Va), das dem Unterschied zwischen den vertikalen Geschwindigkeiten der Achse entspricht, wenn diese bei Auftreffen auf eine Unregelmäßigkeit steigt und fällt, einen Gleichheitsprüfer (K) für den Vergleich des Ausgangssignales (Va) von der Integriereinheit (I) mit einem Bezugssignal (V_{ref}), das einem zulässigen Mindestwert für den Geschwindigkeitsunterschied des Stoßdämpfers entspricht, und eine Anzeigeeinheit (L), die anzeigt, wenn das Ausgangssignal (Va) den Bezugswert (V_{ref}) erreicht.

2. Vorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß zwischen den Beschleunigungsmesser (G) und die Integriereinheit (I) ein Tiefpaßfilter (LF) und ein Verstärker (F) eingelegt sind.

3. Vorrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß der Beschleunigungsmesser (G) ein piezoelektrisches Element enthält.

Revendications

1. Dispositif d'indication de la condition

d'amortisseurs de véhicules à roues par utilisation d'un accéléromètre (G) fixable sur le véhicule, près de l'amortisseur, pour émission d'un signal (S) produisant, par l'intermédiaire d'un dispositif électronique (LP, P, I, K), une indication en cas de dépassement d'une valeur prédéterminée étant fonction de la vitesse verticale, caractérisé par le fait que l'accéléromètre (G) est fixé sur le véhicule, près du moyeu de la roue (H), afin de mesurer, d'une manière continue, les accélérations dues aux oscillations de l'axe (A) de la roue provoquées par des irrégularités verticales de la route, et que le dispositif comprend, en outre: une unité d'intégration (I) pour réception des signaux de l'accéléromètre et émission d'un signal (Va) correspondant à la différence entre les vitesses

verticales de l'axe lorsque celui-ci monte et descend en rencontrant une irrégularité; un comparateur (K) pour comparer le signal de sortie (Va) en provenance de l'unité d'intégration (I) avec un signal de référence (V_{ref}) correspondant à une valeur minimale admise de la différence des vitesses de l'amortisseur; une unité d'indication (L) donnant lieu à une indication lorsque le signal de sortie (Va) atteint la valeur de référence (V_{ref}).

2. Dispositif selon la revendication 1, caractérisé par le fait qu'un filtre passe-bas (LP) et un amplificateur (F) sont insérés entre l'accéléromètre (G) et l'unité d'intégration (I).

3. Dispositif selon l'une des revendications 1 et 2, caractérisé par le fait que l'accéléromètre (G) comprend une pile piézo-électrique.

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